Isotopic tissue fractionation in captive and wild lobsters *Palinurus elephas* (Fabricius1787)

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INTRODUCTION

The determination of isotopic fractionation in tissues is a recent application of the use of stable isotope ^{13}C and ^{15}N in trophic studies. Previous work has showed differences in isotopic fractionation in different tissues in fishes, crustaceans and bivalves (Deudero et al. 2009). A stepwise enrichment of 1‰ in ^{13}C and 3-4‰ in ^{15}N has been demonstrated between prey and consumer tissues, however, the amount of enrichment depends on the tissue type. Abdominal and dorsal muscles have been commonly used. However, as these involve the death of the animal, there is interest in assessing non lethal methodologies (Blanco et al. 2009). For study of *Palinurus elephas,* given its overfished status, we propose the use of leg muscle as a non-lethal technique due the ability to renew the lost limb.

OBJECTIVES

This experimental study aims at providing spiny lobster tissue-specific fractionation for deciphering the best tissue for application of non-lethal techniques in isotopic analyses. We have: (i) analyzed and compared the ^{13}C and ^{15}N isotopic signatures among four lobster tissues (abdominal muscle, leg muscle, telson and hemolymph) and (ii) investigated possible differences in tissue fractionation between wild and captive specimens subject to constant, mono-specific diet in order to test whether there is a tissue-specific isotopic fractionation pattern regardless of the diet.

MATERIALS AND METHODS

Wild and captive adults of *Palinurus elephas* (n= 16) of the NW Mediterranean were analyzed. Wild specimens (80-94 mm carapace length CL) were collected from Columbretes Islands MPA, while captive specimens (84- 108 mm CL) were sampled from Balearic waters, transferred to water tanks for 5 months and fed on a constant diet.

In the laboratory, lobsters were dissected to extract abdominal muscle, leg muscle, telson and hemolymph. Samples were processed and stable isotope ratios were determined. Isotope ratios were expressed in $\delta^{13}C$ and $\delta^{15}N$, with units of ‰, according to the following equation:

$$\delta^{13}C \text{ or } \delta^{15}N = [(R_{sample} / R_{reference}) - 1] \times 1000$$

where R is the corresponding $^{13}C/^{12}C$ or $^{15}N/^{14}N$ ratio

Differences among tissues between wild and captive specimens were tested with PERMANOVA. Homogeneity of multivariate dispersion within tissue were analyzed with PERMDISP. Comparison within tissues of wild and captive specimens were done with U Mann-Withney test. Differences of isotopic fractionation factors ε were also quantified.

RESULTS

- Slight enrichment in ^{13}C and ^{15}N in captive lobsters compared to wild lobsters (Fig. 1) (PERMANOVA, $p< 0.05$).
- $\delta^{13}C$ and $\delta^{15}N$ values of abdominal and leg muscles always more enriched than those of telson and hemolymph (Fig. 2A,B) (PERMANOVA, $p<0.05$) as follows: muscle > telson > hemolymph.
- Hemolymph showed a large amount of variation between samples (0.8±0.14‰ for ^{13}C and 0.6±0.06‰ for ^{15}N), while leg muscle showed less range of variation (0.4±0.09‰ for ^{13}C 0.5 ± 0.07‰ for ^{15}N).

DISCUSSION

- General patterns of tissue fractionation found in the study agree with previous data on tissues in lobster and other crustacean (Schimdt et al. 2004).
- Differences in $\delta^{13}C$ tissue fractionation may be attributed to the relative abundance of lipids, since lipids are depleted in ^{13}C compared to proteins and carbohydrates. Crustacean muscle is considered a lipid-poor tissue, therefore, lean tissues like muscle tend to be isotopically heavier than fatty ones.
- Protein turnover and amino acid composition seems to influence the responses for $\delta^{15}N$. Tissues with lower protein turnover and high concentration of non-essential amino acids, like muscle, tend to be isotopically enriched.
- The controlled diet could explain the slight enrichment observed in captive lobsters compared to the generalist and opportunistic diet in wild lobster populations (Goñi et al. 2001).
- Lower inter-individual variation exhibited by leg muscle makes it the best tissue for elucidating lobster trophic dynamics through stable isotope analysis. Leg muscle is also the more appropriate tissue for non-lethal sampling due to the ability of renewing the lost limb.

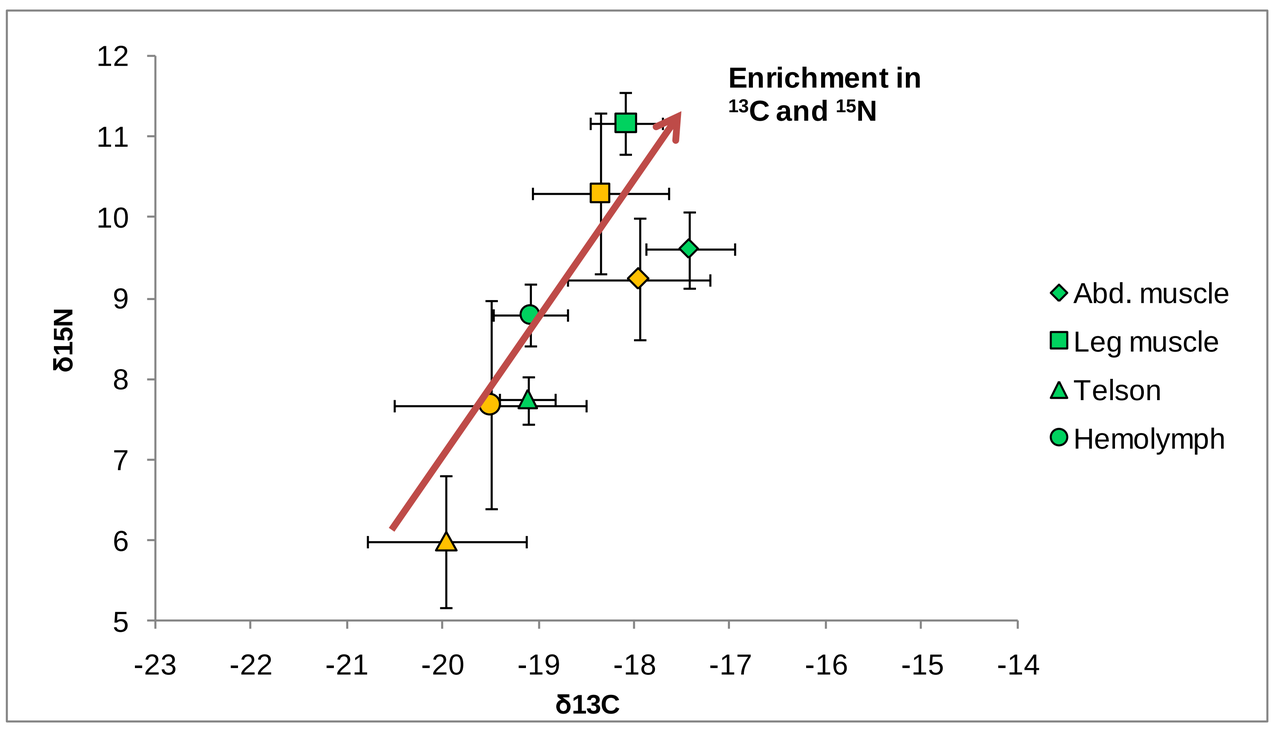

Figure 1. Distribution of tissue isotopic ratios in wild (yellow) and captive (green) lobsters (mean ± SD)

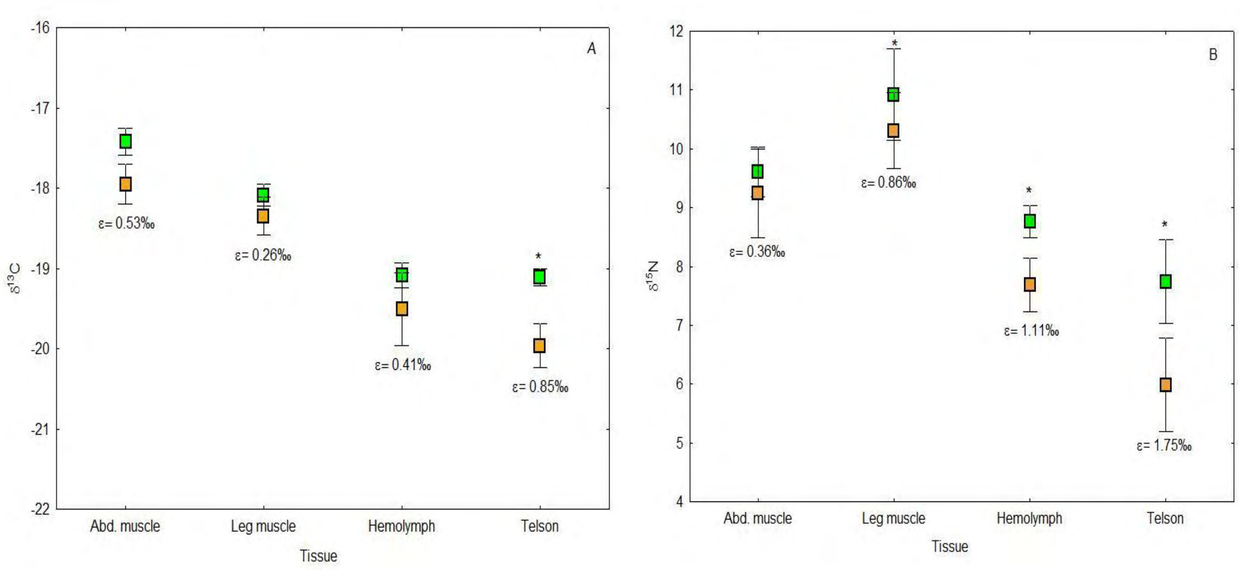

Figure 2. Tissues isotopic ratios for ^{13}C (A) and ^{15}N (B) in wild (yellow) and captive (green) specimens (mean ± SE) (U-Mann Whitney test *p<0.05)

REFERENCES

Blanco A, Deudero S, Box A. 2009. Isotopic fractionation among muscle and scales in marine fishes *Dentex dentex, Argyrosomus regius and Xyrichtys novacula* as non-lethal approximation to fish trophic assessment at Mediterranean waters. *Rapid Communications in Mass Spectometry* 23(15): 2321-2328

Deudero S, Cabanellas-Reboredo M, Blanco M, Tejada S. 2009. Stable isotope fractionation in the digestive gland, muscle and gills tissues of the marine mussel *Mytilus galloprovincialis*). *Journal of Experimental Marine Biology and Ecology* 368: 181 -188

Goñi R, Quetglas A and Reñones O. (2001) Diet of the spiny lobster *Palinurus elephas* (Decapoda, Palinuridea) from the Columbretes Islands Marine Reserve (northwestern Mediterranean). *Journal of the Marine Biological Association of the United Kingdom* 80: 3737: 1-3

Schimdt K, McClelland J, Mente E, Montoya J, Atkinson A and Voss M 2004. Trophic-level interpretation based on $\delta^{15}N$ values: implications of tissue-specific fractionation and amino acid composition. *Marine Ecology Progress Series* 266: 43-58

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